Chapter 2

Unraveling metacognition
Abstract

This chapter introduces a framework of metacognition, in which the construct is considered as a cyclical process. As opposed to most research in which metacognition has been defined in terms of very general or abstract concepts, in our model the construct is described in more concrete terms of (cognitive) activities that take place when students are engaged in metacognition. Building on the work of Nelson and Narens (1990; 1994), metacognition is considered as the interaction between an object- and meta-level of learning, through monitoring and control processes, all informed by metacognitive knowledge. These individual components are described and interactions among them explained, thereby providing insight in the metacognitive process as it can be understood in everyday classroom learning. By explicitly distinguishing the object level, it becomes clearer that characteristics of a learning task influence students’ metacognition. In this chapter, the context of reading comprehension was chosen. Within this domain metacognition has been studied quite extensively, offering fairly adequate descriptions of associated learning activities, specifically monitoring while reading a text (e.g., Pressley & Ghatala, 1990) and the use of reading strategies (e.g., Pressley & Wharton-McDonald, 1997).
2.1 Introduction

Self-regulated learning, an important goal in education (OECD, 2003), comprises cognition, metacognition and motivation (e.g., Boekaerts, 1997; 1999). In traditional education full self-regulation by students is practically impossible because the teacher is bound by curricular demands which direct students' learning to a certain extent. However, already in primary and secondary education children could and should be taught the basic skills necessary to regulate and control their learning in preparation for learning at a later age. These basic skills include planning, monitoring and evaluating the learning processes, as well as applying learning strategies to enhance learning. In order to know when and how to use these skills, metacognition is a crucial element (Pintrich, 2002).

Despite the large body of research available on this topic, the questions as to what metacognition is exactly, and how students’ learning processes can be understood by both themselves and their teachers, have remained difficult to answer (see for example Veenman, Van Hout – Wolters & Afflerbach, 2006, in their introduction to the ‘Metacognition and Learning’ journal). Part of this difficulty stems from the vocabulary used when discussing metacognition; the underlying elements used to explain this concept are mostly fairly abstract. Furthermore, the definitions and models used to represent metacognition do not seem to make these elements much more concrete, as most theoretical frameworks seem to be developed based on the personal interests of researchers, rather than on practical demands (Morris, 1987, in Nelson & Narens, 1994). Next, metacognition seems to be an overall term which refers mainly to thought processes. Capturing these processes is in itself a difficult task and metacognition is often inferred from a variety of overt behaviors, supposed to be activated by covert metacognitive components. To both elevate the scope of the research on metacognition and to be able to use its outcomes in practice, metacognitive concepts should be translated along the lines of what happens in students’ minds when they apply metacognition during learning. Moreover, rather than clinging to the theoretical debate on what metacognition is, which thus far has led to much conceptual confusion, it may be more productive to approach this concept in terms of the activities undertaken by students as indicators of metacognition.

In this chapter a framework for metacognition is proposed, which explains the construct on a more concrete level. In translating metacognition in terms of the (meta)cognitive activities as applied by students, the work of Nelson and Narens (1990)
is elaborated. To consider contextual influences on metacognitive activities, the focus is on comprehensive reading, as this domain has studied metacognition quite extensively while offering fairly adequate descriptions of associated learning activities, specifically the use of reading strategies (Dole, Duffy, Roehler & Pearson, 1991; Jacobs & Paris, 1987; Pressley & Wharton-McDonald, 1997).

2.2 Components of the metacognitive process

Nelson and Narens (1990; 1994) proposed a model of metacognition in which four components can be distinguished: 1) an object-level, 2) a meta-level, 3) monitoring from the object- to the meta-level, and 4) control from the meta- to the object-level. The object- and meta-level are situated hierarchically, with the object-level as the lower plane where the learning task is located. This explicit focus on the learning task is important as it provides the context in which metacognition is understood. At the meta-level, thoughts and knowledge about the object-level are formed. Both levels are related: via monitoring the meta-level receives information about the object-level. At the meta-level, this information is processed to update the knowledge and thoughts about the object-level. In turn, by control (based on this information) the meta-level influences and modifies the information processing at the object level. In this way, Nelson and Narens (1990) have presented a conceptual model to understand metacognition, including four components and the flow of information among them.

There are two major topics that may lead to confusion in interpretation. First, the distinction among multiple components helps to understand the complexity of metacognition. It demonstrates how different theoretical elements are actually all smaller pieces of a larger picture which should be combined into one, to frame the ‘metacognition’ construct as a whole. However, this distinction is artificial and can be considered as a theoretical boundary, as in reality interactions among components take place constantly. Second, also the conceptualizations of the components are still fairly abstract. This is why the remainder of this chapter is focused on describing which (cognitive) activities take place concretely when students engage in metacognition.

Metacognitive knowledge is knowledge about cognition plus the variables that interact with cognition (Flavell, 1979). Although Nelson and Narens (1990) consider this knowledge in their model, they believe that it is stored at the meta-level, thereby interacting only with the model’s other components through its circular causal chain. However, this knowledge may also be considered as a prerequisite to engage in
metacognitive learning processes (Pintrich, 2002). In this way - and as will become clear in the following paragraphs - this knowledge is likely to influence all components of the metacognitive learning process (cf. Ghatala, 1986; Lin & Zabrucky, 1998; Pintrich, 2002). Therefore in het framework considered in this chapter, metacognitive knowledge is situated at the center of the model (see Figure 2.1).

**Figure 2.1: Framework of Metacognition**

In understanding metacognition during learning, it is crucial to gather concrete descriptions of the cognitive activities taking place during all elements of the process, as well as about how they mutually influence each other. In the next paragraphs these elements will be described separately. In the concluding section of this chapter, these interactions are explained and some recommendations for further research are provided.

### 2.2.1 Metacognitive knowledge

Flavell (1979) originally described metacognitive knowledge as knowledge regarding cognition and the variables that interact with cognition. Different types of knowledge can be distinguished (Flavell, 1979; Pintrich, 2002). First, there is knowledge of learning tasks, which can be linked to the object-level in the framework. This type concerns knowledge on the content of, and requirements for tasks, including what demands are put on the student while performing these tasks (Flavell, 1979). In other words, this metacognitive knowledge is needed to understand the object-level and
subsequent interactions with other components. The second category is associated with knowledge of the self as a learner, which relates to monitoring (information processing related to one’s learning process or task performance). In order to engage in monitoring, students need knowledge of what is required of them in a certain learning task, whether they are capable of meeting the demands made, and how they can approach the task the most efficiently. The third category includes knowledge of learning strategies which are at the heart of the control-component in the framework. Within this category three types of knowledge are distinguished again: declarative, procedural and conditional knowledge. Declarative knowledge regards knowledge about salient learning characteristics that affect cognitive knowledge (McCormick, 2003) and learning strategies (Schraw & Moshman, 1995). Procedural knowledge is how-to knowledge; knowledge about how tasks should be executed. In the context of metacognition, it refers to knowledge about how learning strategies should be applied (Jacobs & Paris, 1987). Conditional knowledge is knowledge on why and when to use learning strategies (or other control mechanisms of learning). Without metacognitive knowledge, students are unable to choose and apply strategies successfully (Garner, 1990).

Although most researchers separate metacognitive knowledge from metacognitive control or regulation (e.g., Schraw & Moshman, 1995; Veenman et al., 2006), it is difficult to isolate the knowledge component (Veenman, 2011) because of its relation with all other metacognitive elements. Moreover, as in measuring metacognition it is difficult to capture it directly, it is often inferred from metacognitive activities.

In reading comprehension metacognitive knowledge consists of knowledge about texts and the application of reading strategies. With regards to the first, students should know that there are different types of text, such as narratives and expository texts. For each type of text, students construct schemata (Byrnes, 2001; Dole et al., 1991) which help them understand its structure. Students then can rely on their knowledge to interpret texts and predict how a story unfolds or what information can be expected. This knowledge helps students decide upon which approach to use in reading a text. There are many strategies that can enhance one’s reading comprehension abilities. Students should acquire a repertoire of these strategies, and to build this repertoire, metacognitive knowledge of (reading) strategies is essential. This knowledge can be general (e.g., ‘if I have to remember what a text is about, I could write a summary to remember the most important information’) or tailored to a specific situation or to the strengths and weaknesses of the student (e.g., ‘I find it rather difficult to remember the years mentioned in this chapter, but these are likely to be asked at the upcoming test in history') or tailored to a specific situation or to the strengths and weaknesses of the student (e.g., ‘I find it rather difficult to remember the years mentioned in this chapter, but these are likely to be asked at the upcoming test in history') or tailored to a specific situation or to the strengths and weaknesses of the student (e.g., ‘I find it rather difficult to remember the years mentioned in this chapter, but these are likely to be asked at the upcoming test in history').
class. I should write them down and rehearse them’). Students who possess a high level of metacognitive knowledge approach tasks differently compared to students with a low level of metacognitive knowledge (e.g., Dole et al., 1991). For example, a student with sufficient metacognitive knowledge will think about a task before executing it. In reading this means that the student is aware of the different types of texts, which all require different approaches. Before reading an entire text, the student will therefore first determine what type of text it is and then think about the strategy which has to be used in reading it. A student who lacks this metacognitive knowledge will simply start reading the text without considering its specifics or the tools which can be applied to enhance learning (see also Jacobs & Paris, 1987; Mokhtari & Reichard, 2002).

Having metacognitive knowledge thus also facilitates other aspects of learning, more specifically the ability to monitor and control learning. In reading comprehension students use their metacognitive knowledge as a filter to construct meaning by determining the importance of particular sentences or paragraphs, draw inferences and elaborate on portions of the text (Dole et al., 1991). They use their knowledge to be responsive to the shifting demands of the reading task and continually monitor and evaluate their progress towards the ultimate goal of constructing meaning from the text (Cantrell, Almasi, Carter, Rintamaa, & Madden, 2010).

### 2.2.2. Cognition and metacognition: the object- and the meta-level

Metacognition is interwoven with cognition, often resulting in a complex relation between the two. This complexity is reflected in most definitions about metacognition as well: interpreted as ‘cognition about cognition’ there is no doubt that cognition is necessary for metacognition to exist at all. Even though metacognition draws on cognition (Veenman et al., 2006), and it is difficult to determine where cognition ends and metacognition begins, researchers often try to disentangle the two explicitly. And although it is difficult to discern them separately in terms of learning activities, conceptually a distinction can be made.

In this respect, Nelson and Narens (1990) refer to the lower level (cognition) as the object-level versus the meta-level, where metacognition is situated. At first glance, this contrast seems rather stark, with a learning task situated at the object level, and thinking about that learning task at the meta-level. However, these levels interact within a continuum where they are related. In this continuum a clear boundary is hard to point out. In the case of reading comprehension, instruction usually balances between cognitive and metacognitive aspects and instructional programs focused on the exact
same content may be described as cognitive by some researchers, and as metacognitive by others (Williams & Atkins, 2009). In fact, according to Williams and Atkins (2009), it seems impossible to categorize a particular reading activity as either entirely metacognitive or not-at-all metacognitive. However, when concentrating on both the object-level, where the learning task is considered to be located, and on the meta-level, where thoughts about the task are formed, this distinction becomes somewhat clearer.

In the educational context, the learning task defines the object level. The characteristics of the learning task largely determine the related metacognitive learning process. Not all tasks elicit metacognitive activity, and tasks that do, do not always require the same activities (cf. Lodewyk, Winne & Jamieson-Noel, 2009). Tasks are embedded with instructional cues which provide key information about how students should operate (Lodewyk et al., 2009). In reading comprehension this principle relates, for example, to text structure. A text can be chronological, describing a number of well-ordered events, or non-sequential, describing different time frames in a random order, in which case the readers have to infer the course of the story themselves. The first example is well-structured, whereas the second is ill-structured. Ill-structured tasks, on average, require more strategic responses from students than well-structured tasks, which are clearly defined (Alexander & Judy, 1988). In the former example, students are provided with most or all information needed to execute the task, whereas in the second the ill-structured form demands more reasoning and initiative, which in turn requires more metacognitive activity (Lodewyk et al., 2009). Furthermore, task difficulty also plays a role in students’ need for metacognition in learning. Tasks that are too difficult will not be solved, even when students apply metacognitive strategies, whereas simple tasks will be executed without any need for metacognitive activities (see also McCormick, 2003). For example, a text for grade 6 students will not be understood well by most 3rd graders, no matter how they try, while texts for the 3rd grade will be read without much effort and metacognitive reflection by students of the 6th grade. Texts with new information relating to students’ prior knowledge, texts about a well-known topic but with difficult words, or texts with easy vocabulary but with a difficult subject are all examples of tasks which require metacognitive thinking and control (cf. Garner, 1990).

The meta-level is where one thinks about the object-level and reflects on the metacognitive process (Nelson & Nares, 1990). At this level, thoughts and knowledge about the object level are formed. Because of the cyclical nature of metacognition during learning, both the meta-level and the object-level are continuously subject to change. As the meta-level controls what happens on the object-level (Nelson & Nares, 1990), the
latter continuously alters. When a change occurs at the object-level, the meta-level receives new information and actively responds to it. As the information and thoughts at the meta-level are highly task- or situation-specific, it is hard to describe this level in general terms.

### 2.2.3. Metacognitive monitoring

Once students are engaged in an academic task, the first step in their metacognitive process is monitoring their learning or performance, represented in the framework presented earlier by the flow of information from the object- to the meta-level. Nietfeld, Cao and Osborne (2005) defined this monitoring as “one’s awareness of comprehension and task performance while in the process of performing a specific task” (p. 9). Pressley, Borkowski and Schneider (1989) listed performance monitoring in their model as a crucial component of metacognitive ability, because based on the judgment resulting from this process, decisions are made regarding subsequent actions.

Much research about metacognitive monitoring has focused on the judgment of one’s own learning, which is related to the degree of one’s ability to reproduce or understand materials (e.g., Huff & Nietfeld, 2009). An important distinction is made here between learning and knowing what has been learned. In these types of research interventions students for example have to study material and are asked how confident they were in their ability to reproduce the information later, for example in a test. In this context, a student who exactly knows which items he/she has not yet sufficiently captured and who indeed fails to remember them at the test, is perceived to be more ‘metacognitively aware’ than a student who believes to have answered only half of the items correctly, but who passes the test with, say, a score of ninety percent. The assumption underlying this reasoning is that the more accurate students are in indicating their performance level, the better monitoring has occurred, as they are aware of what they do and do not know.

Multiple terms are known in this respect (Nelson & Narens, 1990): EOL (ease-of-learning), FOK (feeling-of-knowing) and JOL (judgment of learning). EOL judgments are made prior to learning and are merely predictions about the degree of ease or difficulty with which a student expects to perform the learning tasks. FOK and JOL are judgments made during or shortly after learning. Feeling-of-knowing is associated with the likelihood that an item, which at the moment of learning is not yet remembered, is mastered or will be so during a test. Judgment of learning is a prediction about future test performance on items that the learner is aware of while making the prediction.
Tobias and Everson (1996) use the term metacognitive knowledge monitoring to describe the relationship between students’ estimates of how well they are likely to perform on a task and their actual performances; comparable to JOLs. Other related terms are confidence ratings, absolute accuracy and calibration of comprehension (e.g., Lin & Zabrucky, 1998). These are all measures for the degree to which students are able to match their perception of their performance with their actual level of performance (Huff & Nietfeld, 2009).

Studies investigating these measures are often conducted in laboratory environments where students are offered highly specific performance tasks, such as word-number-combinations or paired associates, after which they are asked to judge their learning (e.g., Ariel & Dunlosky, 2011). However, these situations are not entirely representative of reality, as everyday classroom practice is much more complex with its large variety of academic tasks. Furthermore, although monitoring could be operationalized in this way, these judgments do not provide any information about the student’s monitoring process. And if monitoring is input for altering the learning process, these judgments should be made earlier in the process, namely during learning and before being tested. Also when transferred to reading comprehension, these judgments will still not demonstrate whether or not students have monitored their comprehension while reading a text or what happened when they did so.

Research on monitoring-while-reading usually focusses on confronting students with texts containing errors, for example comparisons which are actually contradictions (e.g., Markman, 1979; Oakhill, Hartt & Samols, 2005). The degree to which students notice these errors is indicative of their monitoring ability. Unfortunately, students generally do not tend to notice errors, and - often mistakenly - assume that the text makes sense and that they have understood it. Although understanding a text requires more than decoding the words, students may confuse their ability to read a text technically (on a word-level) with their (higher order level) comprehension of it (Pressley & Wharton-McDonald, 1997). Whenever students make this mistake, the problem is not that they do not understand the text (which could be fixed after re-reading it) but that they are unaware that they do not do so. In this case the reader does not take action, as a result of which his/her lack of understanding is not repaired. This is why monitoring while reading is so important, and why mere judgments on answering a question about a text are not the most informative in this respect. Via monitoring while reading the processes can be constantly altered to improve the understanding of the text. Monitoring while reading can be done by continuously self-questioning whether the text makes
sense, by self-explaining, by making predictions, and so on (Pressley & Wharton-McDonald, 1997). The key element is an active engagement between the student and the text.

Studies of the different types of judgments show the importance of making assessments about one’s own learning, as these judgments provide input for the next step in the learning process. These studies show, for example, that students base their choice of items they want to re-study on their estimated level of knowledge of them (e.g., Thiede & Dunlosky, 1999). Or that they select new tasks based on their judgment of their current performance level (e.g., Kostons, Van Gog, & Paas, 2012). Unfortunately however, these assessments are not always accurate, as the example in reading comprehension already showed. Research (for a review, see Schraw & Moshman, 1995) has indicated that students are poor judges of their own learning, which applies especially to young children. Students often have difficulty in processing a task while they in fact believe that they fully comprehend it. In this case, their monitoring capability is inadequate but they are not aware of this deficit. As a consequence, no further metacognitive engagement is elicited while it is actually required to succeed in learning.

### 2.2.4. Metacognitive control: deciding about learning strategies

The control-component of metacognition refers to means by which students control their learning tasks and/or learning process. In terms of the metacognitive components; it refers to how students influence the object-level, or learning task. An often used interpretation of control involves the selection (and subsequent application) of learning strategies. Broadly defined, students' learning strategies include any thoughts, behaviours, beliefs, or emotions that facilitate the acquisition, understanding, and later transfer of new knowledge and skills (Weinstein, Husman & Dierking, 2000, p.733). Strategies can be understood as procedural, purposeful, effortful, willful, essential, and facilitative (Alexander, Graham & Harris, 1998). Strategies are applied intentionally, after consideration of the demands and progress towards learning goals, with the aim of influencing the learning of and performance in academic tasks. In reading, when being confronted with a text, students make decisions about the strategies they can use to enhance their learning, such as predicting what the text is about and re-reading difficult parts of it.

Many interventions have been conducted in which students were taught to use learning strategies. They took various forms, ranging from learning-to-learn courses in college (e.g., Hadwin & Winne, 1996) to smaller experiments, such as teaching primary
school students strategies for reading comprehension (e.g., Houtveen & Van de Grift, 2007). Although not all of these interventions have proven to be equally effective, it can be concluded that teaching students how to use learning strategies generally improves their performance (see also Chapter Five). The use of learning strategies may start as a goal in itself, as these are taught in isolation. Students are, for example, asked to summarize a book chapter or make inferences while reading. However, as soon as they understand how, when and why to apply the strategies, they will have built their repertoire. The application of these strategies is then no longer a goal but has become a means to another end, that is, to enhance learning.

In referring to learning strategies within the control-component of metacognition, again the interdependency between metacognition and cognition becomes visible. Executing a learning strategy can be considered a cognitive activity whereas the decision to execute that strategy is metacognitive in nature (Veenman et al., 2006). Therefore, deciding to use a learning strategy and choosing the appropriate one is facilitated in the control-component of the framework, whereas the actual application of it is considered to be a cognitive activity, situated at the object-level. There are different views on the (meta)cognitive nature of strategies. Alexander et al., (1998) for example distinguish between general cognitive strategies, which can be easily transferred from task to task as they can be utilized on a broad basis, and domain-specific and task-specific strategies, which are much more content-bound. A third category includes self-regulated learning strategies, which includes planning, monitoring and controlling one’s thinking. However, despite the different labels of the strategy types, there seems to be consensus about the role they play in controlling learning.

Many strategies are known to improve students’ understanding in reading comprehension. These are at the heart of what should be taught in this domain (Williams & Atkins, 2009). Reading strategies can be classified into three main categories: strategies to be used 1) prior, 2) during and 3) after reading (although other classifications could be made as well, see for example Dole et al., 1991). Strategies that could be activated before reading are meant to facilitate the reading process by preparing the conditions for reading. Examples are predicting what the text is about (based on the title, pictures and outline) and activating prior knowledge. During reading there are strategies available to support the monitoring process, such as self-questioning, relating the text to prior knowledge, adjusting the reading speed and re-reading. These last two examples are so-called ‘fix-it strategies’ or strategies to repair comprehension which directly influence the reading process. Strategies that can be used after reading are, for
example, summarizing the main elements of the story or re-telling the story in one’s own
words (Pressley & Wharton-McDonald, 1997). Although these evaluative approaches do
not influence the reading process directly, they help in remembering the read
information and reflecting on the reading process.

Whether or not students use learning strategies depends on multiple factors. For
example, fix-it strategies do not have to be applied in every situation but can be activated
when the text is difficult, or when one has trouble understanding the content. However,
even in these situations students often do not always apply them, due to reasons such as
a lack of knowledge or awareness, or because of motivational issues (Boekaerts &
Niemivirta, 2000; Garner, 1990). The use of evaluative strategies depends, amongst
other factors, on the learning goals. As they assist in memorizing the information, these
strategies are helpful when studying a text before an exam, for example. On the other
hand, when a student reads a book for no other reason than to enjoy him/herself,
evaluative strategies are of less importance.

In order to be able to choose among learning strategies, students have to have
access to a repertoire of these strategies and know how, when and why to use which one
in which situation (procedural and conditional knowledge). Students who have access to
this knowledge and apply it when reading, differ from students who do not use strategies
(cf. Ertmer & Newby, 1996; Mokhtari & Reichard, 2002). For example, when
encountering a difficult part of a text, the reading speed is slowed down or the fragment
is re-read. Students who use their metacognitive knowledge are actively engaged with
the text while reading. Deciding which strategies are required in a specific situation (and
applying them accordingly) is how students control their learning.

2.3. Putting it all together

In the previous paragraphs the metacognitive learning process was described step by
step, focusing on its separate elements. More concrete descriptions were provided by
contextualizing the metacognitive components in the domain of reading comprehension.
Now, all elements are put together. Consider the following example as an integration of
all components into a particular learning task in educational practice:

David is a 5th grade student. He is faced with an assignment for reading
comprehension; reading the following expository text and answer questions about it, to
test his understanding of the topic.
### Thunderstorms

Thunder and lightning occur on a daily basis all around the world. This type of weather is familiar to all of us, but do you know what really happens when thunderstorms take place?

#### Energetic clouds

People used to believe that thunder occurred because the Gods were angry at the people. Now we know that this is not true. Thunder is caused by large temperature differences. Because of these differences, the clouds are charged with energy, like batteries. When the clouds are fully charged, lightning comes down to earth. Sometimes lightning strikes something high up in the sky, such as a tower or a tree.

#### Life on earth

Thunder is important for life on earth. There is an electric field surrounding our planet, which (amongst other reasons) is needed in order to produce rain. This electric field needs energy to exist, and thunder storms are a way to provide this energy. Lightning further creates a substance which plants need to be able to grow. You could think of lightning as some sort of factory which produces a natural fertilizer. Without thunder, there would be no life on earth.

David’s first step is to scan through the text quickly, reading only its headlines and subtitles, to get a first impression of its content. He realizes that it is an informative text, so he expects to learn about thunderstorms, which he finds interesting, and he knows that he has to read the text thoroughly in order to understand it properly. Based on the headings he expects to learn about the clouds where thunder takes place, and maybe something about how people or animals (the ‘life on earth’) respond to thunderstorms. He remembers that about two weeks ago there was a thunderstorm during which the clouds were very dark. As he then felt a bit worried, he hopes to learn more about what actually happens during these storms. These considerations relate to the object-level; the context of metacognition. Furthermore, David’s thoughts and anticipation demonstrate how his metacognitive knowledge is activated - adjusted to the boundaries provided by the object-level - to determine his approach to this reading assignment.

After this orientation phase, David actually starts reading. He regularly stops to think about what he just read. After the second paragraph he tries to summarize the content in his own words. He tests his understanding by self-questioning about how the clouds gain energy. He is able to answer this question (‘this is because of differences in temperature’), which confirms that he still understands the text. David’s thoughts and
activities reflect the monitoring process; while reading he is engaged with the text, considers his progress and reflects on the process of reading and understanding. His metacognitive knowledge provides information on how to interpret the experiences while the reflection takes place at the meta-level. David continues reading, yet he realizes that his mind wanders. He expected to read about people or animals and what to do during thunderstorms, but now he already has read a few sentences and they are all about an electric field and the electricity on earth. Furthermore, the sentence about the ‘fertilizer’ does not make sense to him and he is not quite sure what that word means. Now thanks to his monitoring, he signals that there is a mismatch between his expectations and the actual content of the text. At the meta-level he realizes that he has to take action, so he uses his metacognitive knowledge to consider the options in terms of strategies to fix this situation. He controls his learning by re-reading the last paragraph. When he reads the sentence about the fertilizer for the second time, he understands it – he inferred its meaning from the previous sentence about the substance which plants need in order to grow, which explains that lightning in a way ‘feeds’ the plants. Now, the text makes sense again and David continues reading (returning to the object-level and repeating this cycle numerous times).

This example reflects the metacognitive process: a learner orients towards the learning task (object-level: considering the task demands) and metacognitive knowledge is activated (determining the goal and the approach toward this) to prepare for learning. When he starts working on the task, he monitors his performance (monitoring) and reflects upon his progress at the meta-level. When coming across difficulties, which he signals via his monitoring activities, he analyses the situation (meta-level) in order to define the problem (using metacognitive knowledge) and decides upon a strategy which could solve it. The next step, after making the informed decision about the subsequent course of action, is the actual application of the learning strategy and the continuation of the task at hand: to control his learning and continue with his task at the object-level, focussing on the text again. It is clear from this example that in order to engage in metacognition while learning, both the individual components and the interaction among them need to function adequately.

2.4 Conclusion and implications

Metacognition is an abstract term which is difficult to operationalize. Studies investigating the construct are often merely focussed on single, specific components. As a
result, a broad vocabulary about metacognition has emerged over the past decades. Sometimes different terms are used to describe similar constructs and sometimes the same term is used for clearly different concepts (Reder, 1996). Several researchers have expressed their concern about this lack of clarity. Dinsmore, Alexander and Loughlin (2008), for example, stated that “there are many instances when researchers in this domain contribute to the conceptual haze that blurs their messages and confounds their educational mission” (p. 404).

In order to provide more clarity, this chapter elaborated on the work of Nelson and Narens (1990; 1994) by providing a framework of metacognition including separate elements: 1) the meta-level, where metacognitive reflection takes place, 2) monitoring, as a means to inform the meta-level about learning, 3) control as a purposeful influence on learning processes and outcomes, and 4) metacognitive knowledge, which is the foundation of all other components. Lastly, the object-level was included as this element defines the context of metacognition. In demonstrating the relations among all components, it was shown that metacognition is a complex process which, if executed appropriately, facilitates learning. By describing the individual components and their relations, a contribution was made to the aim of unravelling what is meant under the variety of definitions of metacognition and related constructs.

A second reason for introducing this framework was to operationalize metacognition on a more concrete level and to describe what students who use their metacognition actually do when learning. Describing metacognition in terms of behaviour is helpful for teachers who want to know which students have sufficiently developed their metacognition and which students still need additional help in doing so. Although it is widely recognized that teaching metacognition is important, teachers are often unprepared for this task (e.g., Williams & Atkins, 2009). This situation has been repeatedly pinpointed by the research investigating metacognitive instruction in reading comprehension, which has confirmed that this type of instruction is as yet uncommon (Ness, 2011).

In sum, in this chapter a first attempt was made to bring concreteness to a field that has been associated with ‘fuzziness’, partly because of the large number of definitions, which are each focused on specific parts of the metacognitive process. Rather than defining metacognition primarily as an abstract construct a conceptualization which is usable in the classroom is recommended. Furthermore, a clear emphasis should be placed on both the learning task (the context) and the process-oriented approach, which together provide a fruitful basis for the research on metacognition with an added value to
practice. With respect to the teaching of metacognition, the focus should be placed on learning processes and metacognitive components in line with these processes. As Ertmer and Newby (1996) already concluded, successful students are distinguished not by the amount of knowledge or the number of skills they possess but by their ability to apply these elements flexibly and constructively in their learning. As students are unlikely to develop this ability independently, their teachers are faced with the challenge to instruct them in this task, shifting towards process-oriented teaching. This issue is addressed in Chapter Seven as well.
Chapter 3  
Metacognition and performance in 5th and 6th grade students  

A revised version of this chapter is submitted for publication as:  